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The small-scale manufacture of carbonated beverages

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Introduction

The purpose and scope of the report

This report is one of a series that has been initiated to help prospective investors in developing countries to assess the economic viability of various small scale industries. The manufacturing process is described, and cost models are worked out for different scales of output. Within the overall definition of small scale manufacture, the three scales A, B & C can be described as small, medium and large. These models are intended to be of very wide application to developing countries, so give a detailed breakdown of inputs in physical terms. However, in order to render them more comprehensive, money costs relating to conditions in Western Nigeria have been applied to the physical inputs to act as a concrete illustration. Users in other countries can then substitute their own actual local costs per physical unit to relate the general model to their particular cost conditions. The cost models also indicate the profits that the plants are expected to make, and the return on capital.

The present report deals only with the manufacture of carbonated beverages. Other soft drinks such as pure fruit juices, squashes made from fresh fruit and comminuted drinks are outside its scope. Among the carbonated beverages the manufacture of an orange flavoured drink has been taken as a representative case, and the costing is, therefore, done for this example only. However, with the application of the appropriate recipes, given in Appendix 3, the costs for other drinks can be worked out as well.

Method

The operational data for the three scales of output were collected from various firms engaged in the manufacture of carbonated beverages and complementary goods in the United Kingdom and in Nigeria. The detailed estimates of capital costs were supplied by one of the British manufacturers of machinery for the industry. Some additional information was obtained from Nigeria House and from published sources.

The cost information was then arranged and analysed by conventional accounting methods, deriving gross profit, net profit and return on capital. These calculations are set down in Tables 1 – 4, Appendix 2, and the details of the derivation of the figures are explained in Appendix 1. The data for scale C were further arranged in the form of cash inflows and outflows for ten years, the expected life of the plant. Following current fiscal practise in Nigeria, tax was then calculated at 40 per cent of gross profit, and deducted from the same, after providing for the initial and annual allowances. The plants are not allowed any other exemption from tax as the industry in Nigeria does not enjoy the status of pioneer industry. The internal rate of

return was then worked out on the basis of the after-tax inflow, that is, the rate of discount was found which made the discounted outflows approximately equal to the discounted inflows. Details of this calculation can be found in Tables 5 and 6 of Appendix 2.

Outline of the manufacturing process

The process of bottling carbonated beverages normally involves the use of purchased fruit emulsions or concentrates. It is possible, of course, to begin the process with the production of these flavourings from fresh fruit. However, it is found that large economies of scale are present in the production of these concentrates and emulsions, and in practise nearly all firms engaged in the manufacture of carbonated beverages buy ready-made emulsions. This procedure has the additional advantage of increasing product diversity since no economies of scale are lost through changing flavours, whereas the production of emulsions from fresh fruit is likely to involve the loss of such economies.

First, the dirty bottles are collected on one side and are thoroughly cleaned in the washing machine with a caustic detergent. A common type of machine consists of a moving chain which carries the bottles over and under sprays of detergent and hot clean water. Since the bottles are washed with caustic concentrates, it is important that the solution contains the correct concentration of caustic soda, and that the bottles are completely free from alkali after the wash. The clean sterile bottles then come out on a conveyor to be filled.

The syrup is meanwhile being prepared in tanks placed on an elevated surface. Normally three tanks are used to make the syrup. The sugar, weighed according to the recipe, is dissolved in water in one tank, and the orange emulsion, citric acid and benzoic acid are mixed in the correct proportions in a second tank. The third tank is used to mix the contents of the other two tanks. To a large extent the syrup determines the taste of the final product and it is essential, therefore, that the syrup is made of the right ingredients in the right proportion, is properly mixed and has the correct preservative content. It is necessary to ensure that the water used in making the drink, is pure, clear and treated, and that pure high grade refined white sugar is used which does not affect the taste, clarity or colour of the drink.

The ready syrup now flows through the tubes to the syruper, which puts a fixed quantity of syrup, normally 15 per cent of the bottle capacity, into the bottles. The bottles containing the syrup then arrive at the filler which tops them up with carbonated water. This comes from the carbonating machine which combines the water and carbon dioxide. Most carbonated beverages contain between 3½ and 4 volumes of carbon dioxide which imparts the characteristic taste to the drink. As soon as the bottles are filled with the carbonated water they are sealed with a crowner. Delay in sealing the bottles lets air in, drops the volume of carbonation and leaves the drink with a flat and insipid taste. Once the crowns are on the bottles they are conveyed to the mixer, a machine which turns and shakes the bottles in order that the syrup is properly mixed with the carbonated water.

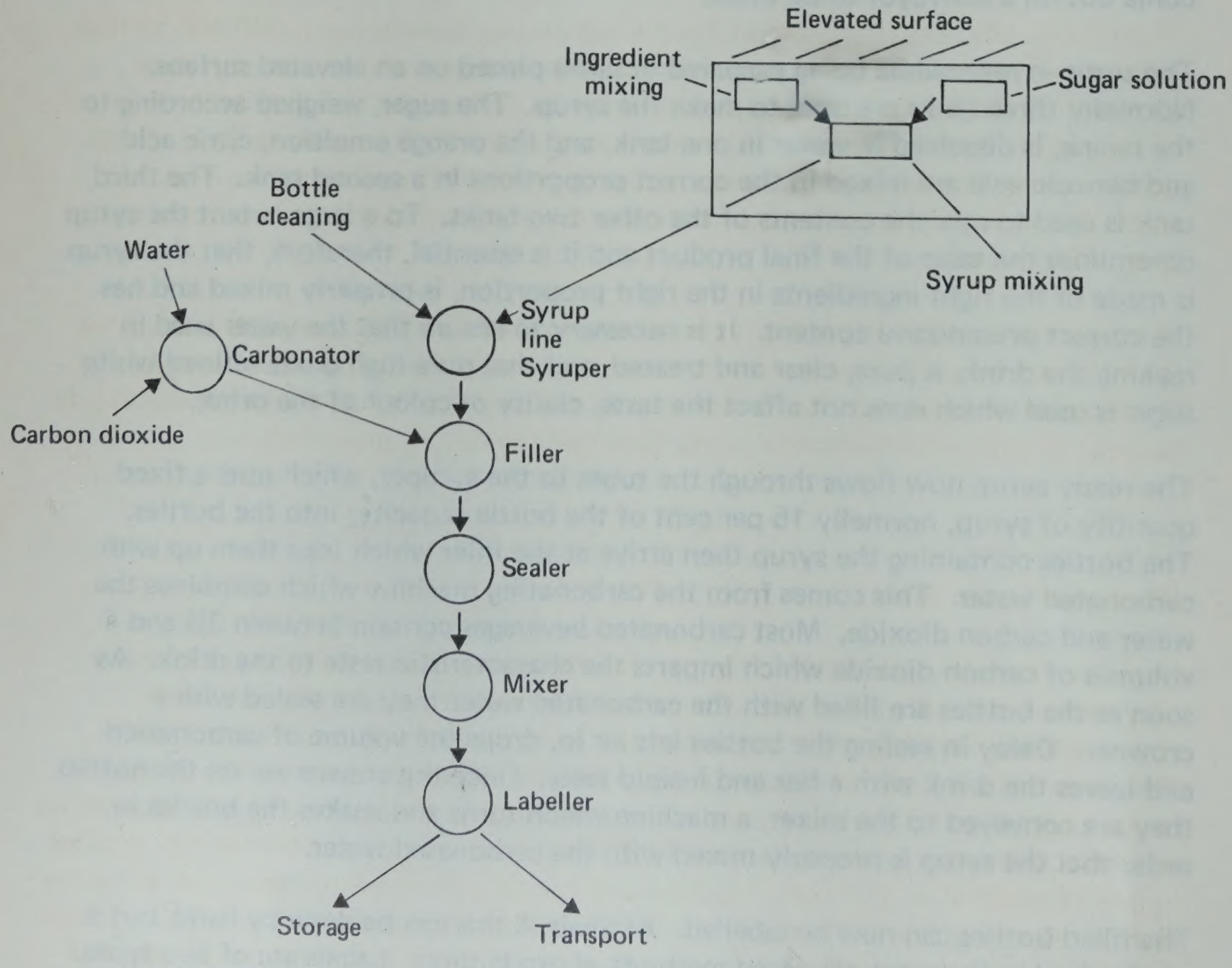
The filled bottles can now be labelled. At Scale A this can be done by hand, but is mechanised in the more advanced methods of production. Labels are of two types, those which are burned permanently on the bottles, and those which are stuck on.

The bottles are then packed in cartons by hand, and either stored for a few days or marketed straight away.

Quality control forms an essential part of carbonated drink production. In the simple process of Scale A, the quality of the product is checked only at the end of the process, whereas in the more sophisticated processes quality is checked at every stage. The most important points to be checked are; the cleanliness of the bottles, the nature of the water for syruping; the proportion of ingredients; the gas content of the carbonated water and finally the 'brix' or sugar content of the finished drink. This latter is most important since a small variation in sugar content can completely change the product.

Since this is a food industry, cleaning is essential and in this case the whole factory, including the syrup tanks, must be properly cleaned every day to ensure a high standard of hygiene. This cleaning must involve more than just the removal of visible dirt, it must also ensure the removal of invisible contaminants such as bacteria or yeasts which can easily develop on the surface of the machines. The plant and equipment is, therefore, cleaned first with a suitable detergent, and then is sterilised by the application of an appropriate agent. Only after the daily clean can the manufacturing cycle be said to finish.

The production method described above is called the 'post-mix' method, that is the syrup and the carbonated water are separate until mixed in the bottles. There is another method, known as the 'pre-mix' method in which the syrup and carbonated water are mixed before they go into bottles. The advantages of the pre-mix system are that it results in quicker production, as the filling has to be done only once, and that the drink is more consistent and uniform. Against these advantages, the pre-mixed solution is more exposed to contamination as it goes through the pipe and cylinder of the carbonater where foreign elements may be present. The danger, of course, can be avoided with extra hygienic care.



FLOWSHEET: this shows the important parts of the process and does not represent the actual layout of a factory.

Summary of results

Rates of return

The smallest of our models, Scale A, describes the actual manufacture of about 500,000 bottles per year, at 245 (10 fl.oz) bottles per hour for one shift per day. On the total investment of £N 7,580 the firm makes an annual loss of about £N 400, i.e. 5 per cent. This rises to a loss of 7 per cent on fixed capital alone. It should be noted from Table 3.2 that labour accounts for a comparatively large proportion of total costs in the case of Scale A, so that in countries where the cost of labour is significantly lower, production at this scale may still be feasible. However, assuming all other costs to remain constant, the unskilled labour wage bill would have to fall by a quarter if the plant were to break even, and the unskilled wage rate would have to be as low as £N 36 per year to yield a 10 per cent rate of return.

Production at Scale B is about 1,000 (10 fl.oz) bottles per hour, or 2,000,000 per year. On the total capital invested of £N 23,170 the gross annual profit before tax is £N 13,760, which yields a return on capital before tax of 59 per cent.

The model indicates that plant at Scale C which produces about 5,000,000 (7 fl.oz) bottles per year, (2,500 per hour), can make very large profits. The cash flow shown in Table 5 suggests that a profit of £N 38,060 would be made in the first year of operation, and that this would increase to £N 52,700 by the tenth year. If 10 years' average annual profit is taken, along the lines of the calculations made for scales A and B, the return on capital before tax and after depreciation works out at over 100 per cent.

It should be noted that the high rates of return postulated for operations at scales B and C rest on certain assumptions about the market for carbonated beverages. It should be stressed that this is a critical factor, and that a full market study should precede any detailed feasibility study based on the figures given here.

Discounted cash flow

In many cases the calculation of returns by the conventional methods used above may be found to be misleading. Therefore, for scale C a model has also been constructed which illustrates the use of the technique of discounted cash flow. This technique is superior insofar as payments throughout the whole life of the project are taken into account, and given an appropriate weighting by the application of a discount rate, or reverse interest rate. The discount rate can be usefully applied in one of two ways. The first is to take a discount rate which represents an adequate rate of return on capital, to apply this to the difference between inflows and outflows over the life of the project, and thereby to arrive at the 'net present value', which if positive, will indicate that the scheme is viable. This type of application is most

useful where alternative schemes are to be compared. The second type of application and that used here, is the 'internal rate of return'. This involves the discovery of whatever rate of discount equalises net inflows and outflows over the period of the scheme. This is more useful where a project is standing on its own in a decision situation.

In the case illustrated in Tables 5 and 6, it turns out that the internal rate of return is 80 per cent, that is lower than the return measured by conventional means. Where such a large rate of return is anticipated the use of discounting techniques is less useful than in cases where the anticipated return is lower, where the more detailed investigation implied by discounting will lead to more positive criteria for decision.

Pay-back period

A third, and cruder method of assessing the viability of an investment is to find the length of time over which the profits from operations will accumulate to a sum which will equal the initial investment. The appropriate formula for this calculation is:

$$\text{Pay-back period} = \frac{\text{Capital cost}}{\text{Gross profit before depreciation} - \text{tax.}}$$

Since, under the assumptions used, the plant at scale A cannot break even, though the loss reduces over time, it is inappropriate to use this formula. The pay-back period for scale B has been calculated as 2.3 years and that for scale C as 1.7 years. These results are consistent with the opinion of one of the machinery manufacturers who told us that they often advance a three years' loan to a customer to buy their machinery, as they reckoned that capital in the industry should easily be recovered in three years.

Economies of scale

If we compare the cost of production at the three different levels of output it appears that economies of scale are obtained when operations expand from scale A to scale B. The unit cost of production in the case of scale A is 8.69 pence per bottle while for scale B it is 6.92 pence. A similar comparison cannot, however, be so easily drawn between scales B and C, as the bottles used are not the same size, due to difference in the design of the plant. In order to make the production cost comparable the unit cost of production has been worked out in terms of cost per gallon rather than in terms of cost per bottle. Ex-factory costs of production per gallon are compared in Table (i).

Table (i)	Unit costs	
Scale	£ per gallon	
A	0.58	
B	0.46	
C	0.47	
C	0.45	*(packed in 10 fl.oz.bottles)*

The cost per gallon thus appears to be lowest in the case of scale B. Though production at scale C is 75 per cent higher, the cost per gallon of drink is higher. It can be argued, however, that this does not indicate the existence of diseconomies of scale. At scale C, since the drink is packed in smaller sized bottles, more bottles are needed, and as a result, more labels, more crowns and more cartons. Table (ii)

shows that comparing scale B with scale C the cost of supplies increases by 5.47 per cent of total ex-factory cost. If the same output were to be packed in 10 fl. oz. bottles, other costs remaining the same, the cost of supplies would represent only 36.76 per cent of the total ex-factory cost, and Table (i) shows the unit cost per gallon would be lower than that for scale B. So economies of scale are being sacrificed to accommodate a different product mix.

Table (ii) Percentage of ex-factory cost

	Scale A	Scale B	Scale C 7 Fl. oz.	Scale C 10 Fl. oz. bottles
Ingredients	14.02	19.81	18.15	21.35
Supplies	28.92	39.19	44.66	36.76
Labour	40.97	22.89	17.17	20.19
Power, Fuel, Water	0.55	1.72	1.89	2.23
Transport	2.53	2.82	4.54	5.33
Other	13.02	13.58	13.59	14.14

In spite of the higher cost of production, the return on capital is highest at scale C. This could be explained either by low capital costs or by high revenues and in this case it is high revenue. By using smaller bottles the manufacturer appears to enter a different market, where proportionately higher prices can normally be charged. The higher revenue per bottle thus more than offsets the extra costs involved in using the smaller bottles.

Small versus large plants

Some of the existing plants in the carbonated beverage industry manufacture 24,000 or 42,000 bottles per hour, that is at a rate of about eight or twelve times greater than the largest scale considered in this report. This poses the question whether small plants can survive under competitive conditions of this nature. Our results suggest that although economies of scale exist in the industry, so that bigger plants can make higher profits, smaller plants can make sufficient profits to exist comfortably. The co-existence of plants of different scales in the industry can be explained by the fact that they often serve different markets and operate at different technological levels. The decision whether to operate on small or large scale, therefore, depends on the resources available and on the size of the market aimed at. Thus although the recent trend has been towards comparatively large scale manufacture, the economic viability of relatively small-scale operation in suitable situations does not seem to be in danger, given appropriate market conditions.

It can be seen from Table (ii) that at scale A labour, and in the other three cases the cost of supplies constitutes the greatest single item. Unlike many other industries the cost of the raw material is comparatively low as water is the main ingredient by volume of carbonated drinks and the cost of ingredients might be even lower if they were not imported. It is also apparent from the Table that as scale increases so does the degree of mechanisation, e.g. the capital invested per head of the total work force is £N 505 at scale A, £N 965 at scale B and £N 1170 at scale C. In other words scale A is a very simple and labour absorbing plant, scale B is semi-automatic and scale C is completely automatic. This is also reflected in the increasing incidence of cost of power. The higher percentage costs of transport at scales B and C reflect differences in the marketing and distribution system of the product. At scale C, with over 5 million bottles to be marketed, it is

unlikely that a firm will be able to sell them all in a local market. In order to reach wider markets in other centres of population the transport cost will thus increase more than proportionately.

Further use of the models

It is useful to examine the effects on the cost models when some of the basic assumptions are changed, especially to see what sort of margins of safety they offer. It can be seen, for example, that if the price of beverages were 3s. per case lower for scales B and C, the plant would just break even, lower prices would lead to loss. Similarly if it is postulated that the plants are only able to operate at 50 per cent of their capacity, due to lack of markets for example, then a loss of over 7 per cent would be made at scale B, while scale C could only maintain a profit in the region of 10 per cent, since more or less the same costs would have to be spread over a lower output. Looked at another way, using the original assumptions, scale B would break even after a fall in sales of nearly 20 per cent, or after an increase in costs of up to 24 per cent. The margin of safety is even higher in the case of scale C. The plant at that scale could absorb without loss a fall in revenue of nearly 24 per cent, or an increase in the cost of production of up to 31 per cent. Scale A can be seen to make a loss under virtually any conceivable economic conditions. It is suggested that users of this report carry out similar exercises with the models on the basis of their own cost structure.

New developments

Containers

Although it has been assumed that the drink is packed in glass bottles, the use of tin and plastic containers is widespread in the soft drinks industry. Plastic containers are not as yet technically suitable for holding carbonated beverages, though development is proceeding on the production of a hybrid plastic-glass bottle, which is a glass bottle having a thin external coating of polyethylene which may be suitable. There has, however, been a trend towards packaging in tins. One fact that emerges strongly is that all existing containers have some advantages and disadvantages, no one type of container is overwhelmingly superior to all others. Glass bottles give a clear view of the contents, have a good re-closure value, are traditional and are very well accepted by the consumer. On the other hand, they are heavy, breakable and relatively difficult to handle. Plastic bottles are light, show the contents, have a luxury image in some cases, are easy to handle and are not prone to breakage. Moreover, at throughputs of over 5 million bottles per year it is thought to be economic for bottling factories to produce their own plastic bottles, thus avoiding the necessity to store bottles, and enabling a rapid response to changes in demand. However, they are likely to be more expensive and have a shorter shelf life. Cans are light, unbreakable, easy to handle and cheap in developed countries. They are unbeatable for speed of filling and closing, and can easily be opened with the new 'ring-pull' ends. However, they have the disadvantages of comparatively poor visual appeal, lack of flexibility in shape and difficulty of re-closure. Moreover the initial cost of a canning line is high and the cans themselves are expensive.

It is difficult to forecast the future of containers in general, though in developed countries, with the widespread existence of self-service supermarkets, a definite preference for one-trip containers has emerged. Increases in income reduce the incentive to collect the deposit on returnable bottles and manufacturers find it more profitable to produce non-returnables. The trend away from glass bottles has been reversed in the United Kingdom recently with the widespread introduction of disposable one-trip bottles, there have been a 300 per cent increase in less than three years. However, in developing countries where bottles are relatively more expensive it is probable that the introduction of one-trip bottles would add too much to the cost of production. In the long run, however, these trends are likely to be reflected in the developing countries, so that it is desirable to keep abreast of developments in packaging.

Standardisation

At present a wide range in packaging materials exists in the carbonated beverages industry, and within the range of glass bottles, for example, there are different

sizes, shapes and colours with various types of closure. This lack of standardisation tends to increase costs without improving the quality of the product in any way. Similarly there is a lack of standardisation of cartons, as far as materials, depth and divisions are concerned and lack of standardisation of pallets. Efforts should, therefore, be made to ensure that within a plant such standardisation is effected in order to reduce costs and as far as possible manufacturers should promote standardisation on an industry wide basis.

Appendix 1

OPERATIONAL DATA AND NOTES ON TABLES

Note should first be taken of certain fundamental assumptions made in constructing the cost models. These are as follows:-

1. The factory operates on one eight hour shift for 5½ days per week, 260 days per year. However, the models can be adapted to show the effects of working a greater number of shifts or days.

2. The operating efficiency is 70 per cent of the throughput specified by the machinery makers.

3. Bottles, sugar, citric acid, orange emulsion and sodium benzoate are imported. All other inputs are available locally.

4. Where prices have been converted into Nigerian currency from Sterling a factor of .857 has been used.

5. The prices quoted are those prevailing in early 1969.

Table 1

The figures given in Table 1 can be derived for the most part from information given in Tables 2 to 4 and from the recipe given in Appendix 3. However, the following items need further explanation:-

line 7 — Bottles: on the advice of firms in the carbonated beverages industry, the figures for the yearly quantity of bottles required allow for an average life of 10 trips per bottle, which takes into account 5 per cent breakage on the production side and 5 per cent loss after sale. The figure for yearly consumption is based on a purchase of 10 per cent of the annual throughput of bottles and the value of sales is adjusted for deposits of 6d recovered on the 5 per cent of 10 fl.oz. bottles lost, and 3d recovered on the 7 fl.oz. bottles lost.

line 8 — Cartons: Each carton contains 24 bottles. It is assumed that 50 per cent of cartons make a second trip, and 10 per cent make a third.

line 16 — Transport: The figures for transport costs are derived from the following table:-

Transport cost at different scales of output			£Nigerian 1969
	Scale A	Scale B	Scale C
Fuel	52	347	1,386
Insurance	100	250	500
Tax	30	80	160
Maintenance	30	100	200
Tyres	80	160	640
	292	937	2,886

The following assumptions have been made in constructing the table:

Scale A – The weight of a carton of full bottles is 26.5 lb, so the total weight to be transported per day is 2,173 lb, slightly less than a ton. Since, owing to poor road conditions, lorries in Nigeria are prohibited from carrying their maximum load, it has been assumed that a plant operating this scale would require a 1½ ton four-wheel diesel van. It has been assumed that this will travel 20 miles per day and use 1 gallon of fuel per 20 miles at 4/- per gallon.

Scale B – The total weight to be carried is approximately 4 tons per day and it is assumed that the firm buys two 3 ton lorries. Each lorry travels 50 miles per day at 15 miles per gallon.

Scale C – The weight of a full carton of 7 fl.oz. bottles is 20.25 lb, so the total weight to be transported per day is 7.6 tons. Since the beverage would have to be transported for longer distances in order to reach a market of the size postulated, it has been assumed that a firm of this size would need to buy at least four 3 ton lorries. Each of these lorries is assumed to travel 100 miles per day at 15 miles to the gallon. Tyres cost £40 each, for scale A & B it is assumed that a pair of new tyres per year will be bought and for scale C that a new set of tyres per year will be required.

line 17 – Rent: The difference in rents between the different scales is explained by the fact that while Scale A and B plants are assumed to be viable in small communities at scale C the plant will need to be established in an urban area of some size where rents can be expected to be high.

Table 2

The following points should be noted:

1. line 7 –Bottles and line 8 – Cartons. The figures given in the 'per shift' columns refer to the average number of **new** bottles and cartons per shift and not to the total number of bottles required. The total requirements can be calculated by multiplying the number of bottles by 10 and for cartons by dividing the total number of bottles by 24.

2. column 0: The figures in this column are derived from the recipe in Appendix 3.

3. The figures for quantity per shift have been rounded in many instances but the annual quantities have been calculated from the unrounded figures, which will account for any discrepancies that may have arisen.

Table 3

1. The figures in this table have been rounded to the nearest £10. Totals have been calculated from the unrounded data, so may not agree with the rounded entries.

2. Building: Scale A — 900 sq. ft. at £2.5 per sq. ft.
   Scale B — 1,400 sq. ft. at £3 per sq. ft.
   Scale C — 1,700 sq. ft. at £3 per sq. ft.

Tables 3 a, b, c.

1. Insurance and freight is calculated at 6 per cent of f.o.b. price.

2. Duty is added at 5 per cent of c.i.f. price.

3. Valuation certificates cost £10 per item.

Table 5

Though no precise marketing study estimating future prices is available the following assumptions have been made:-

1. Owing to the present inflationary trends in western countries, it is assumed that all imported items will increase in price by 5 per cent per year, i.e. lines 1 – 4 and 7.

2. The Gross Domestic Product of Nigeria increased at an average rate of 6 per cent per year over the period 1958–9 to 1966–7 and it is postulated that this rate of growth will continue. An increase of 3.5 per cent per year in the wage rate seems consistent with this rate of growth, since wage rates often lag in developing countries. This applies to lines 11, 12 and 27.

3. On this basis it seems reasonable to assume that prices will increase by 3 per cent per year and this rate has been taken for lines 5, 6, 8, 9, 10, 16, 20, 21 and 29.

4. All other costs are assumed to be fixed or inflexible. Excise duty which is already high is not expected to increase.

Table 6

Column b: It is assumed that lorries are replaced every three years and that they increase in price by 3 per cent per year. The figure for year 11 represents the scrap value of the plant (5 per cent of initial cost plus installation) plus the residual value of the building (10 per cent of initial value), plus imputed value of lorries (33.3 per cent) of year 9.

Column c: Since the cost of inputs is increasing annually, see table 5, working capital requirements will increase annually. It is assumed that the working capital is recovered at the end of the investment.

Column d:	From Table 5, line 30.
Column e:	40 per cent of column d with a lag of one year. It is assumed that tax on profits in year n is paid in year n+1.
Column f:	Nigerian company tax law makes the following allowances to be set against the tax: An initial allowance of 10 per cent of the value of buildings and 15 per cent of plant and installation cost together with an annual allowance of 5 per cent on buildings and 10 per cent on plant and installation. The figures in column f are, therefore, 40 per cent of the value of these allowances.
Column g:	Column b plus column c.
Column h:	Column d plus column f minus column e.
Column i:	The rate of discount is that which most nearly makes the sum of column j minus the sum of column k = 0.
Column j:	Column g multiplied by column i.
Column k:	Column h multiplied by column i.

Appendix 2

TABLES

Table 1 : Production costs, sales and returns — 1969 Nigerian £

		Scale A	Scale B	Scale C	Explanation and Sources
	a	b	c	d	e
	Ingredients				
1	Sugar	1,031	4,242	7,424	Table 2
2	Citric acid	93	382	668	"
3	Orange emulsion	243	999	1,747	"
4	Sodium benzoate	4	16	29	"
5	Carbon dioxide	213	875	1,531	"
6	Washing detergent	36	72	150	"
		1,620	6,586	11,549	
	Supplies				
7	Bottles	919	3,783	7,250	Table 2 and Appendix 1
8	Cartons	1,510	6,006	13,081	"
9	Closures	488	2,009	5,023	Table 2
10	Labels	425	1,223	3,058	"
		3,342	13,021	28,412	
	Labour				
11	Unskilled workers	1,560	2,310	3,420	Table 4
12	Staff	3,175	5,300	7,500	"
		4,735	7,610	10,920	
	Power, Fuel & Water				
13	Electricity	18	273	609	Table 2
14	Oil	–	197	415	"
15	Water	45	102	180	"
		63	572	1,204	
	Other costs				
16	Transport	292	937	2,886	Appendix 1
17	Rent on land	4	6	100	"
18	Insurance (a) building	6	10	13	0.25 per cent of value of buildings (line 3, Table 3)
	(b) plant	6	33	65	0.45 per cent of value of plant (line 1, Table 3)
	(c) stock	6	25	50	0.75 per cent of value of stock (2 months ingredients and supplies)
19	Repairs and maintenance	177	572	977	5 per cent buildings and equipment (line 1 plus line 3, Table 3)
20	Miscellaneous	100	200	500	Estimates
21	Quality control	–	200	300	"
22	Unforeseen	1,035	2,977	5,698	10 per cent of the total lines 1 – 21
23	Interest on working capital	171	491	940	9 per cent of working capital, (line 6, Table 3)
24	Total ex-factory costs	11,557	33,240	63,614	Total lines 1 – 23
25	Depreciation: (a) plant	130	726	1,446	10 per cent of plant (line 1. Table 3)
	(b) building	112	210	255	5 per cent of buildings (line 3, Table 3)
	(c) lorries	500	1,333	2,667	33.1/3 per cent of lorries (line 4, Table 3)
26	Cost of advertisement	902	3,713	7,098	5 per cent of sales (line 30)
27	Excise duty	4,247	17,472	26,390	
28	Salesman	1,000	3,800	6,800	48d per carton Scale A & B, 29d per carton Scale C. See Table 4
29	Total cost of sales	18,448	60,494	108,270	Sum of lines 24 to 28
30	Sales	18,048	74,256	141,960	204d per carton of 10 fl. oz. bottles, 156d per carton of 7 fl. oz. bottles
31	Gross profit before tax	–400	13,762	33,690	Line 30 less line 29
32	Return on capital before tax (per cent).	–5%	59%	80%	Line 31 as percentage of line 7, Table 3

Footnote:

——— subtotal

Table 2 : Physical quantities and prices of inputs

	Inputs	Unit	Scale A: Quantity per shift	Scale A: Quantity per year	Scale A: fob price pence (sterling)	Scale A: Delivered price Nigeria pence	Scale B: Quantity per shift	Scale B: Quantity per year	Scale B: fob price pence (sterling)	Scale B: Delivered price Nigeria pence	Scale C: Quantity per shift	Scale C: Quantity per year	Scale C: fob price pence (sterling)	Scale C: Delivered price Nigeria pence	Quantity per gallon of carbonated drink
	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
1	Sugar	lb	128.6	33,442	NA	7.4	529.2	137,592	NA	7.4	926	240,786	NA	7.4	1.05 lb
2	Citric acid	lb	2.3	597	25.18	37.3	9.5	2,457	25.18	37.3	16.5	4,300	25.18	37.3	0.3 oz
3	Orange emulsion	lb	1.2	299	102	195	4.7	1,229	102	195	8.3	2,150	102	195	0.15 oz
4	Sodium benzoate	lb	0.11	28	25.18	32.8	0.45	117	25.18	32.8	0.81	211	25.18	32.8	0.014(25) oz
5	Carbon dioxide	lb	11.4	2,968	7.5	17.2	47	12,211	7.5	17.2	82.2	21,369	7.5	17.2	0.093 lb
6	Detergent	gal	–	120	NA	72	–	240	NA	72	–	500	NA	72	
7	Bottles	no	196	50,960	–	4.63	806	209,664	–	4.63	2,016	524,160	3.5	3.47	
8	Cartons	no	51	13,272	NA	27.3	210	54,600	NA	26.4	525	136,500	NA	23.0	
9	Closures	no	1,960	509,600	NA	0.23	8,064	2,096,640	NA	0.23	20,160	5,241,600	NA	0.23	
10	Labels	no	1,960	509,600	NA	0.20	8,064	2,096,640	NA	0.14	20,160	5,241,600	NA	0.14	
11	Electricity:														
	(a) Demand charge	kVA	0.4	0.4	NA	360/month	5.7	5.7	NA	360/month	13.2	13.2	NA	330/month	
	(b) Running charge	kWh	3.4	884	NA	3	52.4	13,614	NA	3	120.4	31,294	NA	3	
12	Oil	gal	–	–	–	–	5.04	1,310	NA	36	10.64	2,766	NA	36	
13	Water total:	,000gal	0.7	181	NA	60	1.6	408	NA	60	2.8	719	NA	60	148.88 fl oz
	(a) for syrup	gal	10	2,564			41	10,549			71	18,460			12.88 fl oz
	(b) for carbonation	gal	104	27,073			428	111,384			750	194,922			136 fl oz
	(c) for washing machine	gal	572	148,720			1,080	280,800			1,920	499,200			
	(d) for cleaning	gal	10	2,600			20	5,200			25	6,500			

Sources:

See Chapter 1 'Method' and Appendix 1.

Table 3 : Capital requirements

Nigerian £ 1969

		Scale A	Scale B	Scale C	Explanation
	a	b	c	d	e
1.	Equipment	1,300	7,260	14,460	See Tables 3a, b, c
2.	Installation	110	640	1,290	10 per cent of fob price of equipment
3.	Building	2,250	4,200	5,100	See Appendix 1
4.	Lorry	1,500	4,000	8,000	"
5	Unforeseen	520	1,610	2,880	10 per cent of sum of lines 1 – 4
6	Working capital	1,900	5,460	10,450	2 months running costs (Table 1 lines 1 — 22)
7	Total fixed investment	7,580	23,170	42,180	

Source:

Machinery makers

Footnote:

Figures in this table have been rounded to the nearest £10

Table 3a : Cost of equipment for scale A

	List of equipment	Maximum throughput per hour	h.p. per unit	fob price (£ sterling) 1969	fob (Nigerian £) 1969
	a	b	c	d	e
1	'Meadow' batch type bottle washing machine	192 bottles	–	250	214
2	Stainless steel mixing pan	30 gal	–	NA	50
3	Stainless steel storage pan	30 gal	–	NA	50
4	Stainless steel agitating pan	30 gal	–	NA	50
5	'Delhi' carbonator, filler and crowner	350 bottles	0.5	850	729
6	Set of spares for 'Delhi'	–	–	40	34
7	Quality control apparatus	–	–	25	21
8	Total		0.5		1,148
9	Insurance and freight				69
10	Total price cif				1,217
11	Duty				61
12	Valuation certificates				20
13	Total outlay				1,298

Source:

Machinery makers

Table 3b : Cost of equipment for scale B

	List of equipment	Maximum Capacity	hp per unit	fob price (£ sterling) 1969	fob price (Nigerian £) 1969
	a	b	c	d	e
1	"Apex" washing machine L-3/120..........................	1,440 bottles	3	1,255	1,076
2	One set of spare parts for machine L-3/120...........			95	81
3	"Bratby" No 3 "Disc" water filter..........................	660 gal	½	201	172
4	One set of recommended spares.............................			41	35
5	50 gallon "Bratby" mixer, filter.............................	100 gal	½ + ½	422	362
6	One set of spare parts...			46	39
7	"Bratby" 50 gallon syrup storage tank....................	50 gal		114	98
8	"Bratby" 50 gallon agitating tank...........................	50 gal	2/3	227	195
9	Oil fired re-circulating boiler..................................	126,000 B.Th.U	½	450	386
10	"Speedwell" syruper, filler, crowner.......................	1,440 bottles	1	1,695	1,453
11	One set of spare parts for "Speedwell"...................			129	111
12	HSX conveyor...			608	521
13	"Rapid X" automatic carbonator............................	180 gal	¾	1,061	909
14	One set of spare parts for carbonator.....................			33	28
15	"Thermal" gas tube stand.......................................			101	87
16	Junior labelling machine	2,640 bottles	¼	665	570
17	Simple quality control apparatus............................			350	300
18	Total..		7.667	7,493	6,422
19	Insurance and freight...			450	386
20	Total price cif..			7,943	6,807
21	Duty..			397	340
22	Valuation certificates...			128	110
23	Total outlay..			8,468	7,257

Source:

Machinery makers

Table 3c : Cost of equipment for scale C

	List of equipment	Maximum Capacity	hp per unit	fob price (£ sterling) 1969	fob price (Nigerian £) 1969
	a	b	c	d	e
1	"Autospeed 16" syruper-filler-crowner..................	3,600 bottles	2	4,216	3,613
2	One set of spare parts...			303	260
3	"Centaur" soaker-hydro bottle washing machine	300 doz bottles	4	3,950	3,385
4	One set of spare parts...			150	129
5	"Rapid X" automatic carbonator...........................	180 gal	¾	1,061	909
6	One set of recommended spare parts......................			33	28
7	10 ft inter-connecting piping between "Autospeed" and "Rapid X" carbonator....................................			18	15
8	Additional bottle conveyor inclusive of accumulating table and sighting box.......................			325	279
9	4 Tube "Thermal" gas tube stand with TRV reducer gas manifold warning device to work in conjunction with carbonator..			101	87
10	"Bratby" No 3 "Disc" water filter..........................	660 gal	½	201	172
11	One set of spare parts...			41	35
12	"Bratby" 100 gallon capacity syrup mixer filter......	100 gal	1	642	550
13	One set of spare parts...			49	42
14	"Bratby" 100 gallon capacity agitating tank............	100 gal	1	305	261
15	"Bratby" 100 gallon capacity syrup storage tank......	100 gal		208	178
16	"Patomic" 250 oil fired boiler.................................		1/6 + 1/4	800	686
17	One set of spare parts...			87	75
18	"Bratby" water cooling plant size "XI".....................		7½	1,579	1,353
19	Spare parts..			76	65
20	Syrup cooler..	60 gal	½	375	321
21	Spares...			14	12
22	Quality control equipment......................................			500	428
23	Total..		18hp	15,034	12,884
24	Insurance and freight...			902	773
25	Total price cif..			15,936	13,657
26	Duty..			797	683
27	Valuation certificates...			140	120
28	Total outlay..			16,873	14,460

Table 4 : Labour requirements, wage rates, and total labour costs

		Labour requirements			Wage rate or salary per head per annum 1969 Nigerian £			Total cost per year 1969 Nigerian £		
		Scale A	Scale B	Scale C	Scale A	Scale B	Scale C	Scale A	Scale B	Scale C
	a	b	c	d	e	f	g	h	i	j
	Direct Labour									
1	Collection of bottles.........	1	2	2	150	150	150	150	300	300
2	Washing machine..............	1	1	1	150	150	150	150	150	150
3	Carry to the filler	1	–	–	150	–	–	150	–	–
	or conveyor......................	–	1	1	–	150	150	–	150	150
4	Syrup mixing tanks...........	2	2	2	150	150	150	300	300	300
5	Syruper, filler, crowner......	1	1	1	150	150	150	150	150	150
6	Carbonator........................	–	1	1	–	150	150	–	150	150
7	Carry to labelling machine									
	or accumulating table.........	1	–	–	150	–	–	150	–	–
8	Label and crates................	1	1	2	150	150	150	150	150	300
9	Handling and loading..........	1	1	2	150	150	150	150	150	300
10	Truck driver.......................	1	2	4	160	175	175	160	350	700
11	Helper to truck driver.........	–	2	4	–	160	160	–	320	640
12	Cleaner (½ time)................	1	2	4	50	70	70	50	140	280
	Sub total...........................	11	16	24	–	–	–	1,560	2,310	3,420
	Staff									
13	Manager.............................	1	1	1	1,800	2,000	2,500	1,800	2,000	2,500
14	Maintenance engineer.........	1	1	1	1,200	1,500	1,800	1,200	1,500	1,800
15	Analyst..............................	–	1	1	–	1,000	1,200	–	1,000	1,200
16	Foreman............................	–	1	2	–	600	800	–	600	1,600
17	Clerk and/or secretary........	1	1	2	175	200	200	175	200	400
	Sub total...........................	3	5	7	–	–	–	3,175	5,300	7,500
18	Total labour cost...............							4,735	7,610	10,920
	Sales Staff									
19	Salesmen...........................	1	2	4	1,000	1,000	1,200	1,000	2,000	4,800
20	Sales Manager....................	–	1	1	–	1,800	2,000	–	1,800	2,000

Source:

Chapter 1

Footnote:

________ sub total

Table 5 : Scale C, Cash inflow over 10 years

1969 Nigerian £

	Year	1	2	3	4	5	6	7	8	9	10
1	Sugar	7,424	7,795	8,185	8,594	9,024	9,475	9,949	10,446	10,968	11,517
2	Citric acid	668	701	736	773	812	853	895	940	987	1,036
3	Orange emulsion	1,747	1,834	1,926	2,022	2,123	2,230	2,341	2,458	2,581	2,710
4	Sodium benzoate	29	30	32	34	35	37	39	41	43	45
5	Carbon dioxide	1,531	1,577	1,624	1,673	1,723	1,775	1,828	1,883	1,939	1,998
6	Detergent	150	155	159	164	169	174	179	184	190	196
7	Bottles	7,250	7,613	7,993	8,393	8,812	9,253	9,716	10,201	10,712	11,247
8	Cartons	13,081	13,473	13,878	14,294	14,723	15,164	15,619	16,088	16,571	17,068
9	Closures	5,023	5,174	5,329	5,489	5,653	5,823	5,998	6,178	6,363	6,554
10	Labels	3,058	3,150	3,244	3,342	3,442	3,545	3,651	3,761	3,874	3,990
11	Workers	3,420	3,540	3,664	3,792	3,925	4,062	4,204	4,351	4,503	4,661
12	Staff	7,500	7,763	8,034	8,315	8,606	8,908	9,219	9,542	9,876	10,222
13	Electricity	609	609	609	609	609	609	609	609	609	609
14	Oil	415	415	415	415	415	415	415	415	415	415
15	Water	180	180	180	180	180	180	180	180	180	180
16	Transport	2,886	2,973	3,062	3,154	3,248	3,346	3,446	3,549	3,656	3,766
17	Rent on land	100	100	100	100	100	100	100	100	100	100
18	Insurance										
	(a) building	13	13	13	13	13	13	13	13	13	13
	(b) plant	65	65	65	65	65	65	65	65	65	65
	(c) stock	50	52	54	56	58	60	63	65	68	70
19	Repairs & maintenance	977	977	977	977	977	977	977	977	977	977
20	Miscellaneous	500	515	530	546	563	580	597	615	633	652
21	Quality control	300	309	318	328	338	348	358	369	380	391
22	Unforeseen	5,698	5,901	6,113	6,333	6,561	6,799	7,046	7,303	7,570	7,848
23	Interest on working capital	940	974	1,009	1,045	1,083	1,122	1,163	1,205	1,249	1,295
24	Total ex-factory costs	63,614	65,888	68,249	70,706	73,257	75,913	78,670	81,538	84,522	87,625
25	Cost of advertisement	7,098	7,311	7,530	7,756	7,989	8,229	8,475	8,730	8,992	9,261
26	Excise duty	26,390	26,390	26,390	26,390	26,390	26,390	26,390	26,390	26,390	26,390
27	Salesmen	6,800	7,038	7,284	7,539	7,803	8,076	8,359	8,651	8,954	9,268
28	Total cost of sales	103,902	106,627	109,453	112,391	115,439	118,608	121,894	125,309	128,858	132,544
29	Sales	141,960	146,219	150,605	155,124	159,777	164,571	169,508	174,593	179,831	185,226
30	Gross profit before tax	38,058	39,592	41,152	42,733	44,338	45,963	47,614	49,284	50,973	52,682

Sources:

Table 1, Appendix 1

Footnote:

________ subtotal

Table 6 : Scale C, Discounted cash flow

Year	Fixed capital	Working capital	Gross profit	Tax	Allowances	Net Outflow b + c	Net inflow d + f − e	80 per cent discount factor	Discounted outflow	Discounted inflow
a	b	c	d	e	f	g	h	i	j	k
0	31,733					31.733			31,733	
1		10,446	38,058			10,446	38,058	0.556	5,808	21,160
2		373	39,592	15,223	1881	373	26,250	0.309	115	8,111
3	8,742	388	41,152	15,837	732	9,130	26,047	0.171	1,561	4,454
4		403	42,733	16,461	732	403	27,004	0.095	38	2,565
5		419	44,338	17,093	732	419	27,977	0.053	22	1,483
6	9,552	436	45,963	17,735	732	9,988	28,960	0.029	290	840
7		453	47,614	18,385	732	453	29,961	0.016	7	479
8		471	49,284	19,046	732	471	30,970	0.009	4	279
9	10,438	490	50,973	19,714	732	10,928	31,991	0.005	55	160
10		509	52,682	20,389	732	509	33,025	0.003	2	99
11	− 4,776	−14,388		21,073	732	−19,164	−20,341	0.002	−38	−41
								Total	39,597	39,589

Sources:

Tables 1 to 5 and Appendix 1

Footnote:

remainder 8, therefore internal rate of return is close to 80 per cent.

Appendix 3

RECIPES

The recipes for making various carbonated drinks are given below:-

Orange Squash

Sugar	7 lb.
Citric Acid	2 ozs.
Orange Emulsion	1 fl. oz.
Anteferment Liquid Preservative	½fl. oz.
(16% solution of Benzoic Acid)	
Water to make one gallon	

Lemon Drink

Sugar	7 lb.
Citric Acid	2½ ozs.
Essence	1 fl. oz.
AL Preservative	½ fl. oz.
(16% solution of Benzoic Acid)	
Water to make one gallon	

Kola

Sugar	7 lb.
Concentrate	10 fl. ozs.
Anteferment Liquid preservative	½ fl. oz.
(16% solution of Benzoic Acid)	
Water to make one gallon	

Soda

Sugar	7 lb.
Citric Acid	¼ oz.
Essence	½ fl. oz.
Heading liquid	½ fl. oz.
AL Preservative	½ fl. oz.
(16% solution of Benzoic Acid)	
Water to make one gallon	

Ginger Ale

Sugar	6 lb.
Citric Acid	2 ozs.
Essence	1½ fl. oz.
Colour Liquid Ginger Ale	½ fl. oz.
AL Preservative	½ fl. oz.
(16% solution of Benzoic Acid)	
Water to make one gallon	

Each of these recipes produce one gallon of bottling syrup which should be used at the rate of 1½ fl. ozs. per 10 oz. bottle and filled up with carbonated water in the usual way.

Prices of Essences and Concentrates

In £ Sterling, 1970

Flavour	CIF Price excluding duty shilling	Duty (107½ per cent) shilling	CIF Price including duty shilling
Orange	9/2 per lb	9.855	19.021 per lb
Lemon	12/8 per lb	13.617	26.284 per lb
Cream Soda	10/8 per lb	11.467	22.134 per lb
Tonic Water	28/8 per lb	30.817	59.484 per lb
Ginger Ale	11/8 per lb	15.542	24.209 per lb
Kola	50/10 per gall.	54.645	105.478 per gall.

Appendix 4

ACKNOWLEDGEMENTS

Besides colleagues at the Tropical Products Institute, many individuals and organisations were asked to supply the information or advice on which this report is based and the help of all is gratefully acknowledged. There follows a list of firms and other outside organisations which gave information actually used in the report. (However, none of the models represents the entire practice of any particular firm).

A full list of suppliers of machinery, equipment and other requirements of the soft drinks industry is published monthly in the **Soft Drinks Trade Journal**, The Gate House, 2 Holly Road, Twickenham, Middlesex, England.

1. Barnett, Foster & Bratby (Export) Ltd.,
   Gorton Lane,
   MANCHESTER 18, England.

2. The United Africa Company Ltd.,
   PO Box 1 United Africa House,
   Blackfriars Road,
   LONDON SE1, England.

3. Nigeria High Commission,
   9 Northumberland Avenue,
   LONDON WC2, England.

4. Barnett & Foster Ltd.,
   Denington Estate,
   Wellingborough,
   NORTHANTS, England.

5. Bordpak Ltd.,
   7 Dockyard Road,
   PO Box 369, Apapa,
   NIGERIA.

6. Schweppes (Overseas) Ltd.,
   Schweppes House,
   Connaught Place,
   LONDON W2, England.

7. The Distillers Company (Carbon Dioxide) Ltd.,
Cedar House,
39 London Road,
Reigate,
SURREY, England.

8. Bush Boake Allen Ltd.,
Ashgrove,
Hackney,
LONDON E8, England.